

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

**DCE5038 – ELECTRICAL MEASUREMENT AND
INSTRUMENTATION TECHNIQUES**

(ALL GROUPS)

7 MARCH 2018
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages with 4 questions.
2. Answer **ALL** questions.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [25 MARKS]

a) Define the following terms:

- i) Span. [2 marks]
- ii) Lag. [2 marks]
- iii) Nominal Value. [2 marks]

b) Explain the differences between deflective and null instrument.

[4 marks]

c) State whether the following scenarios are either **accurate and precise**, **precise but not accurate**, or **accurate but not precise**.

- i) Ray Palmer did an experiment to measure the total resistance in a circuit. In his first reading, he measured the total resistance as 20.5Ω . In the second reading, he got 23.5Ω and for his final reading, he got 18.5Ω . The theoretical value for the total resistance for that circuit is 23.5Ω .

[2 marks]

- ii) Clint Barton was able to shoot at the same spot three times. All of it is 50 m away from the bullseye.

[2 marks]

d) Figure 1 below shows a simple series circuit of R_1 and R_2 connected to a 250 V DC source. If the voltage across R_2 is to be measured by a voltmeter having a sensitivity of $5000 \Omega/V$ and on the 125 V range, find the measured voltage, E_L .

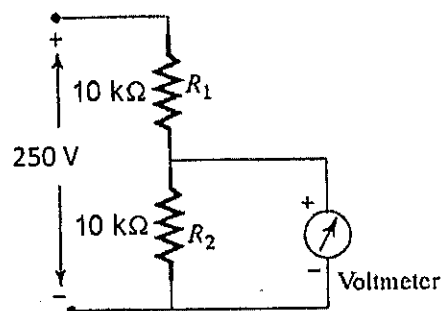


Figure 1

[8 marks]

e) List the aspects that need to be considered in selection of an electrical measurement instrument.

[3 marks]

Continued...

QUESTION 2 [25 MARKS]

a) State **three** types of analog instruments.

[3 marks]

b) State **three** effects that can produce deflecting force in instruments.

[3 marks]

c) Explain **two** effects to the indicating instruments if there are no controlling force within the system.

[4 marks]

d) Draw a simple diagram to show how controlling force and deflecting force act on an indicating instrument.

[1 mark]

e) A permanent magnet moving coil (PMMC) instrument has magnetic flux density of 0.48 T in its air gaps. The diameter and the length of the coil are 1.25 cm and 2 cm respectively. With the number of turns, N is 320 and torque of $3.24 \mu\text{Nm}$ is produced, find the coil current needed.

[4 marks]

f) Briefly explain the operation of induction wattmeter.

[10 marks]

Continued...

QUESTION 3 [25 MARKS]

- a) Describe the three classifications of resistance, and suggest one method to measure resistance of 0.25Ω .
[4 marks]
- b) A Maxwell inductance bridge uses a standard of $C_3=0.1\mu F$ and operates at supply frequency of 100 Hz. Balance is achieved when $R_1=2k\Omega$, $R_3=470\Omega$ and $R_4=500\Omega$. Determine:
i) L_s .
[3 marks]
ii) R_s .
[3 marks]
- c) In a Carey-Foster's bridge, a resistance of 1.0125Ω is compared with a standard resistance of 1Ω . The slide wire has resistance of 0.0250Ω in 100 divisions. The ratio arm are 10Ω each. At what position does balance is obtained?
[5 marks]
- d) In Schering bridge circuit shown in Figure 2, it consists of $C_2 = 0.1 \mu F$ and $R_3 = 2 k\Omega$. C_4 is adjustable from $0.1 \mu F$ to $0.5 \mu F$. R_4 can be adjusted from $0.5 k\Omega$ to $1.0 k\Omega$. Find the span of capacitance C_1 and resistance R_1 that can be obtained with this bridge.
[10 marks]

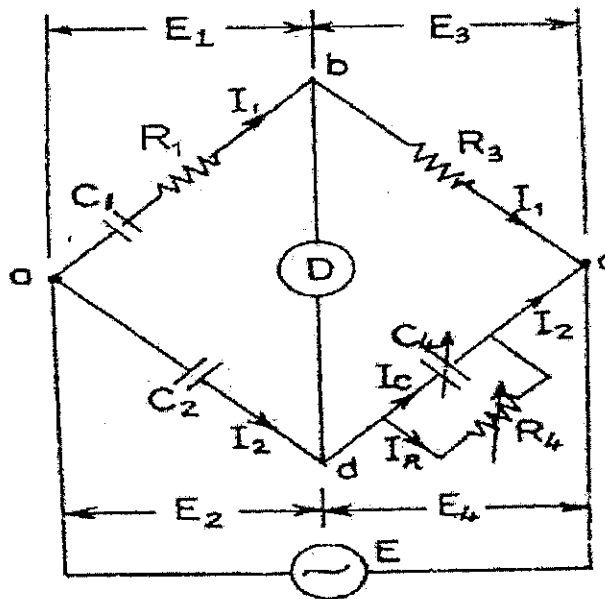


Figure 2

Continued...

QUESTION 4 [25 MARKS]

- a) Given an iron ring that have a primary winding of 100 turns and secondary windings of 150 turns. The cross sectional area is 20 mm^2 with a mean length of 20 cm. On the reverse current of 2 A, calculate:

i) The magnetic force produced.

[3 marks]

ii) Permeability if the flux density produced is 0.125 T.

[3 marks]

- b) Given the formula to find the temperature measured in a thermistor system is

$$R = R_0 \exp \left[\beta \left(\frac{1}{T} - \frac{1}{T_0} \right) \right]$$

If β for the thermistor is 3221K and the resistance at 27°C is 1014Ω , by utilizing the formula $T_{(K)} = T_{(^\circ\text{C})} + 273.15$, find the temperature if the measured resistance is 2000Ω .

[4 marks]

- c) Figure 3 depicts the output of a Linear Differential Transformer (LVDT). Calculate:

i) Sensitivity of the LVDT.

[3 marks]

ii) Output voltage if the displacement of the object attached to it is 30 mm.

[3 marks]

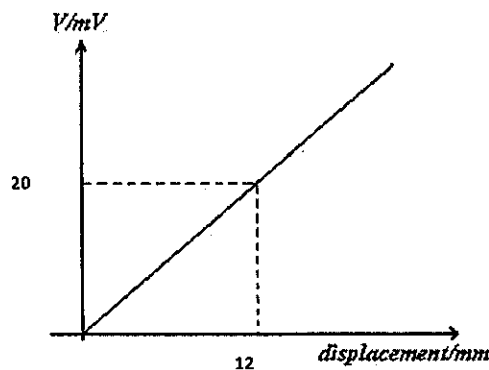


Figure 3

- d) A quartz piezo-electric crystal having a thickness of 3 mm and a voltage sensitivity of 0.155 Vm/N is subjected to a stress of 1.2 MN/m^2 . Calculate the output voltage and its charge sensitivity, if the relative permittivity of the quartz is 4.5.

[9 marks]

End of Page.